Investigation 4

What Is a Quadratic Function?

When you jump from a diving board, gravity pulls you toward Earth. When you throw or kick a ball into the air, gravity brings it back down. For several hundred years, scientists have used mathematical models to describe and predict the effect of gravity on the position, velocity, and acceleration of falling objects.

Did You Know?

Aristotle, the ancient Greek philosopher and scientist, believed that heavier objects fall faster than lighter objects. In the late 1500s, the great Italian scientist Galileo challenged this idea.

It is said that, while observing a hailstorm, Galileo noticed that large and small hailstones hit the ground at the same time. If Aristotle were correct, this would happen only if the larger stones dropped from a higher point or if the smaller stones started falling first. Galileo didn't think either of these explanations was probable.

A famous story claims that Galileo proved that heavy and light objects fall at the same rate by climbing to the highest point he could find—the top of the Tower of Pisa—and dropping two objects simultaneously. Although they had different weights, the objects hit the ground at the same time.

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4.1 Tracking a Ball

No matter how hard you throw or kick a ball into the air, gravity returns it to Earth. In this problem, you will explore how the height of a thrown ball changes over time.

Problem 4.1 Interpreting a Table and an Equation

Suppose you throw a ball straight up in the air. This table shows how the height of the ball might change as it goes up and then returns to the ground.

Height of Thrown Ball

Time (seconds)	Height (feet)
0.00	0
0.25	15
0.50	28
0.75	39
1.00	48
1.25	55
1.50	60
1.75	63
2.00	64
2.25	63
2.50	60
2.75	55
3.00	48
3.25	39
3.50	28
3.75	15
4.00	0

A. **1.** Describe how the height of the ball changes over this 4-second time period.

2. Without actually making the graph, describe what the graph of these data would look like. Include as many important features as you can.

3. Do you think these data represent a quadratic function? Explain.

B. The height h of the ball in feet after t seconds can be described by the equation $h = -16t^2 + 64t$.

1. Graph this equation on your calculator.

2. Does the graph match the description you gave in Question A? Explain.

3. When does the ball reach a height of about 58 feet? Explain.

4. Use the equation to find the height of the ball after 1.6 seconds.

5. When will the ball reach the ground? Explain.

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